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The Aëronautical Journal.

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NOTICES OF The Aëronautical Society.

At a meeting of the Council of the Aëronautical Society of Great Britain, held at the Society of Arts on March 17, 1904, the following were elected members of the Society :—

MR. WILLIAM BEEDLE.

MR. WILLIAM HENRY CADMAN, B.Sc., F.C.S.

MR. CHARLES LESLIE WALKER.

MR. WILLIAM ELIS WILLIAMS.

The next general meeting will be held at the Society of Arts, John Street, Adelphi, in July, the date of which will be duly announced. Amongst the papers will be one on "The Measurement of Air Velocity and Pressure in Aëro-Dynamic Experiments" and "The Balloon Anemometer," by Professor A. F. Zahm, of Notre Dame University, Indiana, U.S.A.

THE LIBRARY.

Arrangements have been made for the Library of the Society to be open to members for reference and the borrowing of books on the first Monday in the month from 2 to 5 p.m., except when the first Monday falls on a Bank Holiday, in which case it will be open on the following Monday.

The following books and publications have been kindly presented to the Library :— By Mr. William Marriott : "My Life and Balloon Experiences" (Henry Coxwell), and "Some Account of the Meteorological Work of the Late Mr. James Glaisher" (William Marriott). By Mr. A. Lawrence Rotch : "Meteorology at the British Association" (Lawrence Rotch). By Mrs. Tidswell : Typewritten Extract from Sir Hiram Maxim's Essay Competing for Smithsonian Institution (Washington) Prize, December, 1894.

ANNUAL SUBSCRIPTIONS.

The annual subscriptions to the Aëronautical Society of Great Britain became due on January 1. Those members who have not yet paid their annual subscriptions are requested to forward them to the Honorary Secretary, 53, Victoria Street, Westminster, London, S.W. The attention of those members is called to Rule IVA, which states that the privileges of members extend only to those who have paid their subscriptions for the current year.

ERIC STUART BRUCE,
Honorary Secretary.

The late Sir Edwin Arnold.

It is with sorrow that we have to announce the death of an illustrious and esteemed member of the Council of the Aëronautical Society of Great Britain. On March 24, Sir Edwin Arnold, Author of "The Light of Asia," breathed his last.

In the many biographical sketches of the poet that have been published, and which have so ably detailed his literary work and other pursuits, it has escaped the pens of the writers that in addition to the wide range of subjects that Sir Edwin Arnold's sympathies embraced was the science of aëronautics. This fact it becomes the special duty of this journal to record. Of late years, ill-health had deprived him of the possibility of actively taking part in the deliberations of the Council of the Aëronautical Society of Great Britain, but not very long before his death, in a letter received by the Honorary Secretary of the Society, the continuance of his sympathy with the aims and objects of the Society was warmly expressed.

In the *Daily Telegraph* of March 25 there appeared an excellent and heartfelt account of the life and labours of Sir Edwin Arnold, the more heartfelt because that journal had been so intimately associated with him for over forty years, during which time he worked on its editorial staff, and those who wish to esteem aright, the genius, talent, industry, achievements, distinctions, and sterling personal qualities of our late Councillor may well peruse this summary.

Amongst the excellent traits of personal character mentioned in this eulogy is his "temper of imperturbable sweetness," noted in "his sunny optimism." These qualities made it possible for him to fight political battles with vigour, but not with rancour or unfriendliness of speech, so that the words of his pen seemed an expression of his own translation of the Buddhistic rule.

. . . "govern the lips as they were palace doors, the King within; tranquil and fair and courteous be all words which from that presence win."

General Meeting.

The second meeting of the Thirty-ninth Session of the Aeronautical Society of Great Britain was held at the Society of Arts, John Street, Adelphi, on Thursday, March 17, 1904, the President, Major B. Baden-Powell, in the chair.

The President: Ladies and Gentlemen, I will ask the Honorary Secretary to read the minutes of the Society.

The Honorary Secretary read the minutes.

Experiments with Aerial Screw Propellers.

By MAJOR B. BADEN-POWELL.

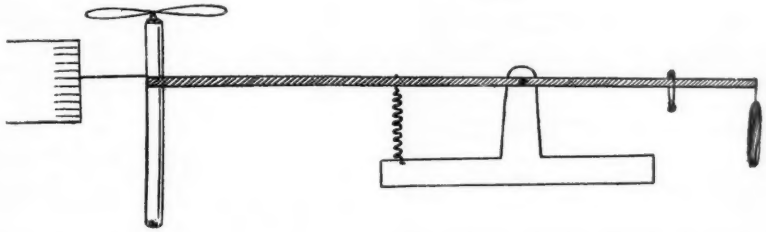
These experiments, though they have continued over a considerable period of time, are, unfortunately, by no means conclusive in results. I may as well explain how and why I conducted them. Actual trials of aërial propellers have not very often been made, or perhaps I should say that the results of such trials have not often been published. This latter may be for two reasons: 1st, that inventors wish to keep the results of their investigations to themselves, which, though somewhat selfish, is but natural. 2nd. The results may be such that the experimenters do not think them worth recording. I have considered whether I should not comply with this second reason, and simply look upon the results of my work as negative and not worth recording. But on second thoughts I determined to publish some account of what I had done in the hope that it may possibly be useful, even if only in preventing others from wasting time by going over the same ground. I think, however, that some few of my deductions may even be more useful than this.

For aërial work it is possible that screws may be used in two ways—as propellers to drive the apparatus horizontally, and as lifters to raise it vertically.

My idea at first was to test screws as horizontal propellers, but I soon came to the conclusion that this would require a large space, whether the experiments were conducted on a whirling table, or on a travelling carriage. The lifting screws, on the other hand, to raise a weight off its support, need take up but very little room. For

this reason I decided that my first trials, at all events, would be with lifting screws. I may here point out that the conditions between the two kinds are somewhat different and distinct, and it does not at all follow that a screw of a given shape which exhibits great efficiency as a lifter is necessarily a good form for propulsion.

I must then say a word as to the motive power I employed. At first I proposed to use a petrol motor, and fitted one up, but experienced considerable difficulty with the machine, and soon realised that to get an efficient apparatus for my purpose would involve much expense and time in arranging clutches and gearing, &c. I may say, however, that I hope to be able eventually to use such methods. I next tried an electric motor, but here again practical difficulties cropped up, which finally



decided me to adopt for this preliminary work the rather primitive system of winding up a band of indiarubber. This method has the advantage of extreme simplicity and reliability. Its duration of running is quite long enough for the purpose. It is noiseless, and gives no smell or smoke, so is very convenient for home experiments.

The india-rubber consisted of four strands 43 inches long, and weighed four ozs. Two hundred winds was the maximum, but as it several times broke when wound to this extent, I usually only wound it 150 times.

My apparatus, then, consists of the following:—

A bar of wood 7 ft. long is pivoted at a point 22 in. from one end. On this end a weight is hung as counterpoise; a sliding weight can be adjusted to balance any extra weight of the screws, &c.

On the other side of the pivot, and about 10 in. from it, a light spring holds the bar down, so that as the screw lifts the spring becomes more and more extended and thus the actual strength of the lift can be measured. At the outer end of the bar is attached the "motor," consisting of two bamboo rods 3 ft. 8 in. long attached by cross-pieces at the top and bottom, the strands of india-rubber being attached to a fixed hook on the lower cross-piece, and at the top to a steel hook, the shaft of which passes through the upper cross-piece and is rigidly connected with the table on which the propellers are attached. This arrangement is, in principle, exactly similar to that of the well-known toy butterfly. From the end of the arm a light pointer projects which moves in front of a dial so that the actual lift of the screws, in ounces, can at once be read off. I also arranged an arm to move across a cylinder rotated by clockwork to record the results.

Needless to say, many of the earlier experiments were not satisfactory, through various errors of the arrangement, but as finally modified it gave great satisfaction.

I have records of some 350 different tests, but as many were duplicated and many abortive, I need only refer here to certain results obtained, without describing each experiment in order.

The screws experimented with were mostly cut out of tin. They had a slot in the centre which fitted on a staple connected with the upper hook of the motor, and were held in place by a wedge.

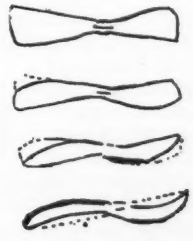
Though a few other screws were also tried, the principal tests were made with the following:—

A.—16 in. diam., greatest width 3 in. .. ..

B.—The same with front corners cut away. .. ..

C.—The same cut away to back edge .. ..

D.—The same with the after edge cut away .. ..



E.—Still more cut away, 1 in. wide.

F.—18½ in. diam., 1½ in. wide.

G.—A large paper screw, 28 in. diameter.

H.— .. ..

I.—16½ in. × 3¾ in.

J.—18½ in. × 2½ in.

K.—Four bladed, 9 in. diam. ..

L.—20 in. × 1¼ ..

M.—20 in. diam ..

N.—18½ in. × 1in.

N_1.—Similar to N, capable of being placed crosswise.

O.—18 in. ..

P.—Like J, but double thickness —section ..

In addition to these various shapes, each of the propellers could be bent to any desired angle of pitch. They were also curved, more or less.

The angle of the pitch of the screws was measured as follows :—

Cards were cut so that the top presented a given angle to the sides. A different card was used for each angle. The top of the card was held under the screw blade, and the edge of the card held so as to correspond with the upright of the frame.

The curvature was taken by a simple instrument consisting of a card graduated from the centre outwards. An arm, also graduated, was pivoted near one end, and by this means the height of the curve in the centre could be measured.

The times of running were noted by stop watch. As there were (usually) 150 revolutions a simple calculation gave the number of revolutions per minute. This timing, however, could not be very accurately taken, as the motion often slowed down gradually.

Pitch.—It seems as if we had here a definite result in favour of an angle between 15° and 20°.

Expt.	Screw		Pitch. deg.		Lift. ozs.	Time secs.	Rev.
177	F	surface flat	20		3	6	1500
178	F	,, ,,	15		3½	5	1800
202	L	flat	10	150 turns	3¾	10	900
203	L	,,	15		4	12	750
240	L	curve 1 : 4½	10		2½	12	750
242	L	,,	15		3	14	630
243	L	,,	20		3	14	630
272	M	,,	15		3¼	10	900
273	M		20		4¼	8	1125
292	I	1 : 6	15		2⅝	13	
293	I	,,	10		2	13	

Expt.	Screw.	Curve.	Pitch. deg.	Lift. ozs.	Time. secs.
301	I	1 : 7	25	3	16
302	,,	,,	20	3¼	15
303	,,	,,	15	3½	13
304	,,	,,	10	3¼	11
305	N_2	1 : 5	15	3¼	6
306	,,	,,	30	3	8
310	N_1	1 : 10	15	4¾	6
311	,,	,,	20	3¾	8

The conclusions from these are that 15° is evidently better than 10°, but they are not decisive as regards 15° and 20°. 25° and 30° are evidently worse.

Another result, also not novel (but I took nothing for granted), is that a curved surface that is concave underneath is more efficient than a flat one.

Expt.	Screw.		Pitch. deg.	Lift. ozs.	Time. secs.
155	F	curved	15	3½	5
157	,,	flat	,,	3	6
158	,,	,,	,,	3	5
159	,,	curved	,,	3⅝	5
160	,,	,,	,,	4	5
162	,,	flat	,,	3	5

But in this, as in some of my other experiments, there seem to be exceptions —thus

Expt.	Screw.		Pitch. deg.	Lift. ozs.	Time. secs.
196	K	flat	25	4	5
197	,,	curved	25	3½	5

The amount of curvature of course affects the question, and in the above it was not measured.

Expt.	Screw.	Curve.	Pitch. deg.	Lift. ozs.	Time. secs.
237	L	1 : 9½	15	4½	12
250	,,	1 : 8½	15	3½-4	12½
238	,,	1 : 6	15	3½	13
239	,,	1 : 4½	15	3	14
303	I	1 : 7	15	3¼	13
308	,,	1 : 10	15	3¾	11

If the amount of curvature be greater towards the front the lift seems to be less.

Expt.	Screw.		Curve.	Pitch. deg.	Lift. ozs.	Time. secs.
242	L		1 : 4½	15	3	14
244	,,		1 : 4½	,,	2¾	14
245	,,		,,	,,	,,	,,
246	,,		,,	,,	2¾	15
247	,,		,,	,,	,,	,,

A decided result is obtained by turning up the posterior edge.

Expt.	Screw.		Pitch. deg.	Lift. ozs.	Time. secs.
263	J	1 : 13	10-15	3½	13
270	,,		15	2½	10
271	,,		15	not 1	10

A peculiarity of this method of testing, which is not easy to account for, is that under certain conditions the pointer rises straight to the maximum and remains there for some time—under other conditions it rises gradually to the maximum. It also generally falls away gradually. The curves may be represented thus:—

Expt.	Screw.		Pitch. deg.	Lift. ozs.	Time. secs.
186	H	curve	15	5	4
188	F		15	4½	8½
238, &c., various	L	curves	10-15	3-4½	12-14
249	L	curve 1 : 6	15	3	14
250	L	1 : 8½	15	3½-4	12½
272	M	flat	15	3¼	10
293	I	1 : 8	15	3¼	12

Sometimes these movements are erratic, undulating rapidly up and down. Such is usually the case with screws with curved blades.

Some interesting results were obtained with four-bladed screws.

N and N_1 were similar screws that could be put on together.

Expt.	Screw.		Pitch. deg.	Lift. ozs.	Time. secs.
219	..	N_1	15	4¾	7
220	..	N	15	5	7
222	..	N & N_1	15	3½	9

So that the four-bladed turns slower (more resistance) and give less lift than the two-bladed.

If these screws were put so that the blades were superposed the results were not as good as when forming a four-bladed screw of "cross" plan +.

Expt.	Screw.			Pitch. deg.	Lift. ozs.	Time. secs.
221	..	N & N_1	superposed	15	3	10
222	..	,,	crossed	,,	3½	9
223	..	,,	superposed	,,	3	9
224	..	,,	crossed	,,	3½	9
318	..	,,	crossed	1 : 10 20	3½	10
319	..	,,	superposed	,, ,,	3½	9
320	..	,,	crossed	,, ,,	3¾	9
322	..	,,	superposed	,, 15	3	8
323	..	,,	crossed	,, ,,	4	8
324	..	,,	superposed	,, ,,	3	8½

As for the *shape*, that is, the plan of the screws, I am not at all convinced which is the best. On the whole I find a long narrow oblong shape like L as good as any, and very steady in running. A sickle shaped (E, H, M) blade promises well, but is erratic.

These, then, are some of the principal results obtained. As I have said, they are not very conclusive, and one only learns what a great amount of trial is necessary before any definite result can be arrived at.

The apparatus is simple and easily made, and forms a fascinating toy to play with at odd moments, and I shall be very glad to hear that others have made similar contrivances, and of the results that they obtain.

Dr. Barton: I wish to say a few words to thank you for the paper you have just given us. It is a most interesting subject, and I quite agree it is a subject, in common with other subjects on aeronautics, in which research should be made. I think the means you are employing are certainly most excellent, and if your experiments could be carried out on a larger scale I think it would be better, especially with a reliable motor —electrical motor for preference—because then you can exactly estimate what h.p. you are using. With regard to the superimposed type of propeller, Mr. Walker has made the most exhaustive experiments with that type and he finds that by duplicating the blades he gets nearly double the power of a single blade, and so on with triple and quadruple blades. I hope to have my own running at the end of the week, and I shall be able to tell you what the results are on a large scale. I should like to know whether those blades that are superimposed are flat.

The President: They are curved now, but I have tried them flat.

Dr. Barton: And you have had the same result?

The President: Practically. I will show the figures later on.

Dr. Barton: We are making experiments

ourselves at the Alexandra Palace, and I daresay before long we shall be able to let you have some notes of what we have done there.

Professor Everett: I should like just to make a suggestion or two. Of course, it is not a new thing in the world, driving a vehicle by means of screw propellers. Steamers have been driven that way, and I was going to suggest that the experience that has been acquired in the screw propellers on steamers would naturally form the first foundation for experiments on aerial propellers, and one would think that the proper way would be to begin with a propeller of the same shape as that which has been adopted for steamers, and then to find in what direction departure from that form is advantageous. One point occurs to me in connection with that. So far as I remember the shape of screw propellers, if they are applied to this purpose they ought to be steeper in the centre than at the outside, and the reason for that is pretty obvious. One can easily understand that the blade ought to be curved, because when the blade first cuts the air, the air is at rest, but the first edge of the blade drives the air downwards, so that the middle and hinder edge of the blade are passing through air that is already moving downwards, and therefore it stands to reason the blade must have a bigger slope or it won't press the air down. As to the two-bladed, one over the other, giving nearly double the lifting power, that is nothing to boast of, because if you put them at right angles they will give nearly or quite double the lifting power of a single pair.

The President: If no one else wishes to make any remarks, I think, as regards this subject, I have nothing very much to add as to the shape of the propellers; they might be better, as you say, if they were higher in the middle; but that was done for the convenience of cutting them out of tin, and I do not think that affects the question so very greatly, because it is only the centre of the screw, and it is the outer edges which are the important parts to consider. As for that superimposed screw which Dr. Barton referred to, my experiments are rough, and it is a point I must investigate more before I can give any very definite information.

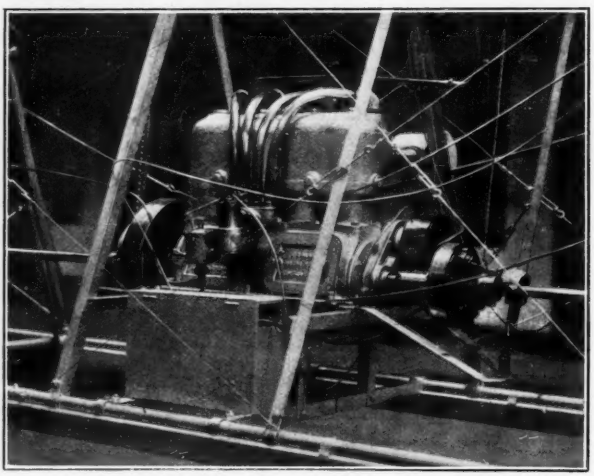
The President: Mr. Beedle will now read his paper on the Beedle Airship, which I have no doubt many of you have heard of. It underwent some trials at the Alexandra Palace not very long ago.

The Beedle Airship.

By W. Beedle.

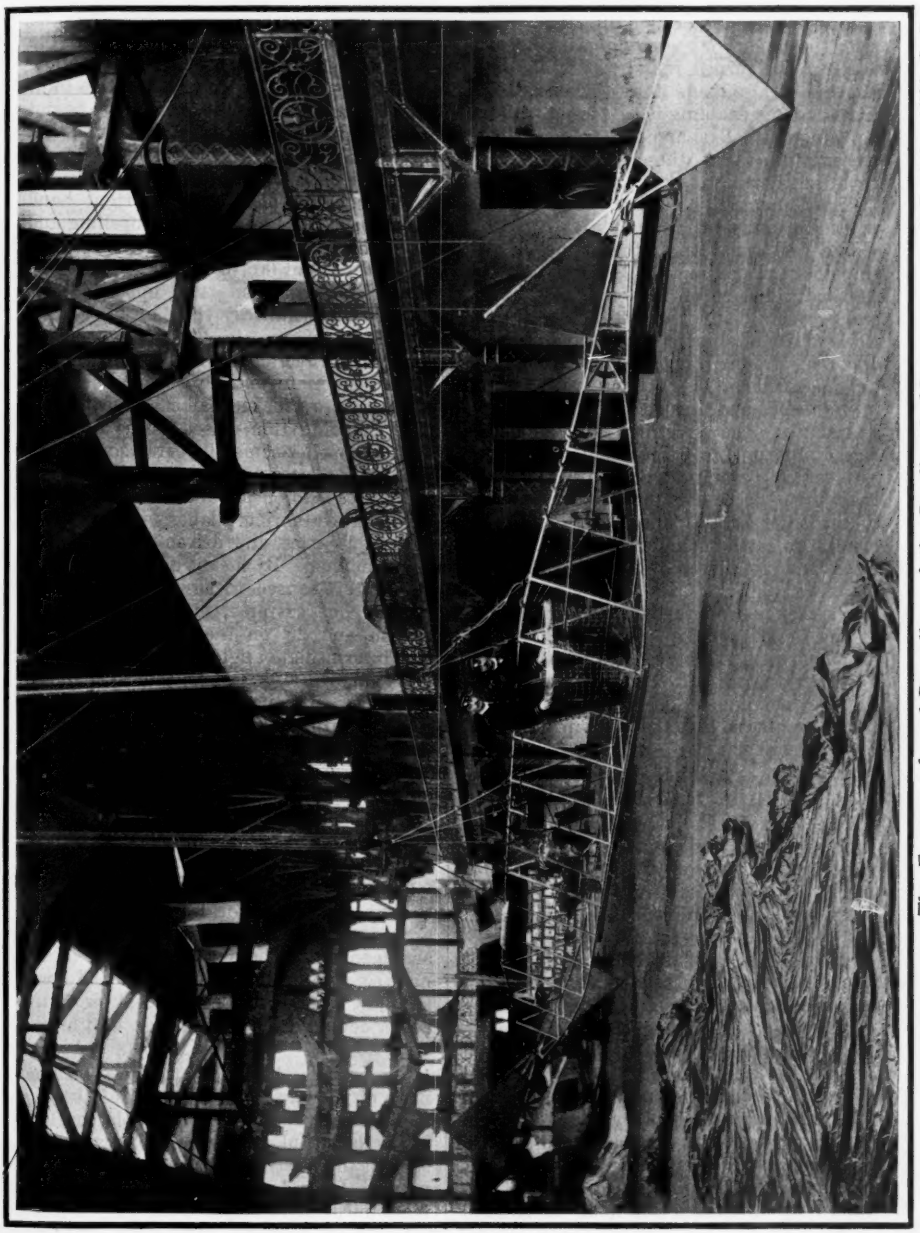
Mr. Beedle: I have great pleasure in demonstrating my method of steering and controlling airships by this model.

I dispense entirely with the rudder at the rear, and thereby avoid a great deal of air resistance, and use instead a fan in front which is able to work vertically,



By Permission of "The Car."

The Motor of the Beedle Airship.



The Framework and Propellers of the Beedle Airship. *By Permission of "The Car."*

horizontally, or obliquely, thus being able to raise or lower the machine at pleasure, or to turn it in any desired direction.

By the use of my steering-gear the airship can be turned round within its wn length, and also made to rise when heavier than air, thus enabling it to ascend without throwing out ballast and to descend without opening gas-valve, these being two very important items.

(The demonstration of the working model was successfully carried out.)

The first trial trip of this novel airship took place in the grounds of the Alexandra Palace on November 3, 1903, and proved a distinct success. The framework of the airship is constructed of cold-drawn steel tubing, is 50 feet in length, and weighs 800 lbs. The driving fan is 14 feet in diameter, and revolves 300 revolutions a minute; the steering fan, which is placed in front, is 8 feet in diameter, and revolves 250 revolutions a minute. This has been proved to be able to turn the machine to the right or left, and to raise it up or bring it to earth at the will of the aëronaut. Both fans are driven by a motor of 15 h.p., made by Blake, of Kew Gardens. I hope to commence some further trials in April.

The President: The next paper is one on Mechanical Flight, by Mr. Thomas Moy. I regret to say Mr. Thomas Moy is laid up by bronchitis, and is unable to come here to-night, so that the paper will be read by the Secretary.

Mechanical Flight.

By Thomas Moy.

The soap bubble and the projectile illustrate the two opposite extremes of mechanical flight.

The two greatest hindrances to the solution of this problem have always been the balloon and the screw propeller.

People pick up this and that old device, and fancy that a merely new combination will answer their purpose. The balloon is one such device, having one chief function—that of flotation. Balloon troubles and risks are so well-known to every member of this Society that they need no description. The very obvious schoolboy device of elongating the bulb and driving it end-on with a screw propeller has only resulted in the attainment of a feeble speed, not hitherto exceeding 10 miles an hour in a dead calm.

The screw propeller, as applied to a marine vessel, is entirely immersed in a fluid nearly 800 times denser than air, and has but one function to perform, viz., that of propelling the vessel horizontally, no lifting power being required; therefore the screw propeller would be entirely inapplicable if it were possible to apply it to a bird. In the wing of the bird it is shown to be not only possible but absolutely imperative that the propelling and lifting functions should be combined. In the diagram exhibited, the descending plane on the right hand side of the axis imparts a propelling and lifting force like the wing of a bird, through a space of about 60° of the circle; but the ascending plane on the opposite side entirely neutralises the lifting function just referred to, by acting in a downward direction. This absence of the lifting function entirely disqualifies the ordinary screw for mechanical flight.

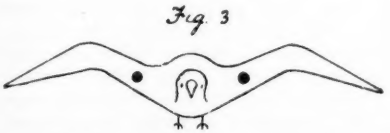
Recognising this defect in the ordinary screw propeller some 30 years ago, I made use of two driving and partially lifting screws, each of 6 feet diameter, and fitted with six feathering planes, revolving on horizontal axles, and driven by a 2½-horse power engine. By means of eccentrics the planes were caused to assume an angle of 15°, as one extreme, on their downward motion, and 25° on their upward motion. The intermediate angles arising from positions above and below the axle being graduated by the eccentrics. By these means I utilised that section of the screw's path which virtually imitated the bird's wing. I also obtained some wind pressure *under* the ascending plane on the opposite side, in imitation of the aëroplane action of the upper arm, and also utilised the function of the screw propeller throughout some of the remaining sections.

On further reflection I resolved that this arrangement was far inferior to the wing arrangement. There was too much of the mere screw propeller in the upper and lower sections, whereby the economical use of the power could not be compared to that of the wing action.

As I shall show you that we have no need of the screw propeller or of the gas bag, let both be dismissed, and let us look at the beautiful adaptation of large birds, such as the Australian crane, to well-known natural laws, by the application of which mechanical flight may become the speediest, safest, most delightful, and most economical means of travel.

We know that when a cake of dynamite

is placed against a citadel door and fired, the air acts as a solid anvil, and the door gives way. The air has not sufficient time to give way to the dynamite, therefore the door is shattered. The bird utilises this property of the air in accomplishing its flight.



Let Fig. 1 represent a large bird in the air in a stationary position, and therefore without forward motion, and just about to commence falling. Some of you who have shot large birds know very well how quickly they fall. There is not much of the parachute about it. The areas of its wings and tail are insufficient to perceptibly reduce its speed of downward fall. We may therefore reckon that the bird will fall one foot in a quarter of a second, and its centre of gravity will have attained a speed of 8 ft. per second.

Although the bird is furnished with upper arms and forearms jointed together for the convenience of folding, yet, when in flight, the two arms are rigidly outstretched. I will therefore call them the inner levers. The bones of these inner levers are heavily loaded with muscle, and the bird prevents the fall of its body by throwing down its inner levers, as indicated in Fig. 2. The centre of gravity of each half of the bird may be assumed to be at the spot shown on the drawing. These centres of gravity would be made to fall (say) 2 ft. in this quarter of a second, and the combination of the three bodies, viz., the central body and the two inner levers, thus fulfil the requirements of the law of gravitation, with the expenditure of a very small amount of power. The bird also thus acquires, by what I may call the cheapest means, a terminal speed at the outer end of these inner levers, of something like 30 ft. per second. Thus the body of the bird, and particularly its digestive organs, are enabled to retain a perfectly horizontal line of flight, without deviating an eighth of an inch therefrom, while a powerful momentive force is acquired by the inner levers, with the very best means for acting as fulcrums for the muscles which operate the pinions, and imparting thereto the required downward thrust, whereby the bird is driven forward with the necessary rapidity. The parallelogram of forces shows that the pinion affords both a forward thrust and an upward lift, the latter being utilised in raising the inner levers to their normal position ready for the next stroke, as shown in Fig. 3.

I am perfectly sure that the momentum of the downward stroke of the inner levers is fully utilised by their action on the pinions, and that it is by these means that the bird is enabled to strike the air with a speed and force which is ample for its safety in flight.

I anticipate that the utilisation of the momentum derived from the descent of the inner levers is the only point likely to be disputed. Now some of you are old enough to have seen the flail in use in threshing corn, the flail consisting of two rods loosely hinged together. In this we have the equivalents of the bird's inner lever and the pinion. It is obvious that there is an upward thrust at the joint where the two levers meet when the outer one strikes the corn, as well as an upward thrust received by the man's hand, when threshing.

This little model illustrates the upward force imparted to the body of the bird by the rapid descent of the inner levers. The model weighs altogether 4½ ounces. The levers are loaded at their outer ends with half an ounce of lead. Now you will see that the rapid fall of these two half-ounce weights imparts to the whole 4½ ounces sufficient lift to raise the model.

Coming back then to the flail, I have proved that we can obtain an upward thrust or lift at the shoulder. The outer end of the inner lever receives a downward motion of very great velocity. This gives great momentive force at the joint, which is absorbed and utilised by the outer lever.

By driving the inner levers downwards with a moderate and economical force, the

bird's body is sustained in space, as it travels horizontally. By the greater muscular energy imparted to the pinions, the latter not only propel the bird but also raise the inner levers to their initial position. The pinions, being light, are easily raised to their normal position ready for their next stroke.

What I have described can be readily modified and adapted to mechanical flight by suitable motive power. High-speed is indispensable, but great economy in motive power can be secured by intermittent driving, with periodic spells of gliding; the effects of the reciprocating motions being absorbed by the divided leverage, and the body of the bird being unaffected by the vibration of its limbs.

Professor Everett: I am one of those who are old enough to remember the use of the flail in threshing. There was no spring connection; the second piece was merely attached by a loose piece of leather. It is simply the principle of the whip; the part the man holds is like the whip handle, and the part that strikes the corn is like the thong, and the man gives the necessary momentum. When the handle is brought down the man suddenly stops and the second piece comes down with its own momentum and strikes the ground. In the case of a bird the wind is not heavy outside. Surely, what a bird does with its wing is to pull down the outside, not to thrust it down and let it go as a stone in a sling goes, but to force it down. As to the distinction which has been made between the action of a propeller in lifting and the action of a propeller in driving forward, is it a sound one? What you want to do is to drive the air in the opposite direction to that in which you want to go yourself. Whatever momentum you communicate to the air in one direction you and your carriage will give it an equal momentum in the opposite direction, so that I say there is no benefit in giving two separate impulses, one downwards and one to the edge. It would surely be more effective to give one impulse to the air in the intermediate direction, exactly opposite to that in which you want to go. Although the force of gravity makes you accelerate, and the resistance of the air to forward motion is a steady resistance, yet still with a certain forward velocity through the air there will be a definite opposing horizontal resistance, just as with gravity there is a definite downward tendency, and the impulse you exert must be in the direction given for combining these two resistances.

Mr. Frost: I thoroughly agree with the observations of the last speaker, but he has taken every word out of my mouth. Every word he has said seems to me perfectly true, so far as I have studied the subject of natural flight.

The President: Well, we have no further paper to-night. I do not know that I need add any remarks to those that have already been made. It is a pity Mr. Moy is not here, else he might have shown us more clearly some of these ingenious little models which are here, because, of course, it is very difficult to explain what they are meant for when one has never seen them worked, and one does not know what they are meant to show. We are now to have some photographs thrown on the screen descriptive of the gliding experiments of the brothers Wright. Most of you know about the brothers Wright and the experiments they have been making in America — how they have been making some very good glides, and how just lately they have applied a motor to their machine and made some very successful experiments in rising off the ground into the air. Although some of the newspaper accounts were much exaggerated, there is still no doubt that some of the experiments were very satisfactory, and are amongst the most satisfactory ever made in human flight. I believe it is quite untrue that they travelled anything like three miles, because it was the very first trial of a new machine, and they did not think it worth while making any prolonged flight. We will now see the pictures.

A series of pictures were then shown on the screen, depicting a flight of a Wright gliding machine, including getting a start, in mid-air, skimming the ground, and landed.

Mr. Frost: Ladies and gentlemen, before we separate I rise to propose a vote of thanks to our worthy Chairman, Major Baden-Powell, and at the same time to thank him for the most interesting paper he read at the beginning of the meeting.

The Hon. Secretary: Dr. Mill was obliged to leave before the close of the meeting, and had he been present he would have most warmly seconded that vote of thanks to our Chairman, but in his absence I must do so on his behalf.

The vote of thanks having been unanimously carried,

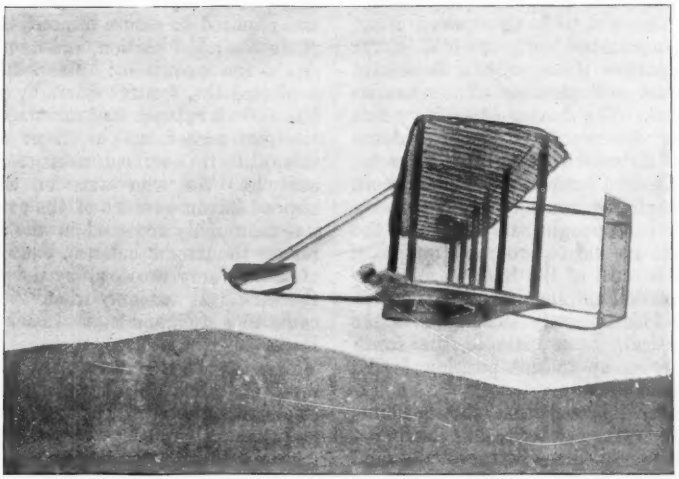
The Chairman said: Ladies and gentlemen, I am very much obliged to you for your kind vote of thanks, and also for your attendance here this evening.

The proceedings then terminated.

The Experiments of the Brothers Wright.

1. With Gliding Machines depending upon Gravity for their Motive Power.

The number of successful glides accomplished by Mr. Wilbur Wright and his brother, with their double-decked gliding machine in America, would seem to be a proof of the value of those careful preliminary experiments which it has been the custom of these intrepid aviators to originate. After their first experiments, made with gliding machines in 1900 and 1901, they undertook laboratory experiments for the purpose of determining the amount and direction of the pressures produced by the wind upon plane and arched surfaces exposed at various angles of incidence; upon the results of these experiments a new pattern machine was constructed in 1902.



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A Wright Gliding Machine.

In a paper entitled "Experiments and Observations in Soaring Flight," read by Mr. Wilbur Wright, before the Western Society of Engineers, the details of this machine are given. It is a double-decked machine having two surfaces each 32 feet from tip to tip, and 5 feet from front to rear. The total area of the main surfaces is about 305 square feet. The front rudder spread 15 square feet additional and the vertical tail about 12 square feet. This was afterwards reduced to six square feet. The weight was 116½ lbs. Including the operator the total weight was from 250 to 260 lbs. It is stated that the machine was built to withstand hard usage, and it underwent no less than one thousand glides, with only one injury, though it was subjected to immense strains from landing at full speed in a slight hollow where only the tips of the wings touched the earth, the entire weight of machine and operator being suspended between them. The scene of operations in the second series of experiments was the same as in the former ones, the Kill Devil Hills. These rise from a level plain of bare sand, and may be described as mounds of sand heaped up by the wind, and which constantly change in height, and slope according to the direction and force of the prevailing winds. The three hills used for the experiments were known as the Big Hill, the Little Hill, and the West Hill, and have heights of 100 feet, 30 feet, and 60 respectively.

Before entering upon the gliding experiments with the new machine, the excellent precautionary measure of flying the machine as a kite was adopted so that it might be ascertained whether the machine would be capable of soaring in a wind having an up-

ward trend of a trifle over 7 degrees which was the slope of the hill up which the current was flowing. Mr. Wilbur Wright explains that by soaring he means not only that the weight of the machine is fully sustained, but also that the direction of the pressure upon the wings is such that the propelling and the retarding forces are exactly in balance, that is the resultant of all the pressures is exactly vertical, and therefore without any unbalanced horizontal component. A kite is soaring when the string stands exactly vertical, this showing that there is no backward pull. The phenomenon is exhibited only when the kite is flown in a rising current of air. In principle, soaring is exactly equivalent to gliding, the practical difference being that in one case the wind moves with an upward trend against a motionless surface, while in the other the surface moves with a downward trend against motionless air. The reactions are identical. The soaring of birds consists in gliding downwards through a rising current of air which has a rate of ascent equal to the bird's relative rate of descent. Testing a gliding machine on a suitable slope with just enough wind to sustain the machine at its most favourable angle of incidence is one of the most satisfactory methods of determining its efficiency. In soaring, a kite must fly steadily with the string vertical, or a little to the front. Merely darting up to this position for an instant is not soaring.

Experience showed that the machine would soar on the side of a hill having a slope of about 7 degrees whenever the wind was of proper force to keep the angle of incidence between 4 and 8 degrees.

Actual free flights with the glider showed that the indications of the kite experiments were correct. Several hundred flights were made along the full length of this slope, and landed a short distance out on the level ground. It was found that with this new machine there were greater disturbances of the lateral equilibrium than in the case of the former one, and as there were some differences in the construction of the new machine, attempts were made to ascertain which of these were responsible for the greater unsteadiness. Alterations were made at the wingtips, which were brought down six inches lower than the centre. Glides were then undertaken to test the effect of the alterations. One of these flights was undertaken by Mr. Orville Wright,and it very nearly proved disastrous, though it was the only accident which happened during these experiments. The flight is thus described :—

"After a few preliminary flights to accustom himself to the new method of operating the front rudder, he felt himself ready to undertake the management of the lateral control also. Shortly afterward he started on a flight with one wing slightly higher than the other. This caused the machine to veer to the left. He waited a moment to see whether it would right itself, but, finding that it did not, then decided to apply the control. At the very instant he did this, however, the right wing most unexpectedly raised much worse than before, and led him to think that possibly he had made a mistake. A moment of thought was required to assure himself that he had made the right motion, and another to increase the movement. Meanwhile, he had neglected the front rudder, by which the fore and aft balance was maintained. The machine turned up in front more and more, till it assumed a most dangerous attitude. We who were on the ground noticed this in advance of the aviator, who was thoroughly absorbed in the attempt to restore the lateral balance, but our shouts of alarm were drowned by the howling of the wind. It was only when the machine came to a stop, and started backward, that he at length realised the true situation. From the height of nearly 30 feet the machine sailed diagonally backward till it struck the ground. The unlucky aëronaut had time for one hasty glance behind him, and the next instant found himself the centre of a mass of fluttering wreckage. How he escaped injury I do not know, but afterward he was unable to show a scratch or bruise anywhere, though his clothes were torn in one place."

In connection with this accident, Mr. Wilbur Wright mentions that for the purpose of reducing the danger to the lowest possible point, they usually kept close to the ground—skimmed it sometimes at the height of only a few inches. It was their object to avoid any unnecessary risk. While high flights are spectacular, the low ones are quite as valuable for practice. "Skill comes by the constant repetition of familiar feats rather than by a few over-bold attempts at feats for which the performer is yet hardly prepared."

As the result of several trials, it was decided that the best plan to secure lateral equilibrium was to make the vertical tail

movable, like a rudder. As originally built, the fixed vertical tail was double, but in changing to a movable rudder it was made single. It spread a little less than six square feet. With this improvement of detail, serious troubles ended, and the experimenters were able, by constant practice, to concentrate themselves on the work of gaining skill. Of these most interesting practices Mr. Wilbur Wright says: "When properly applied, the means of control proved to possess a mastery over the forces tending to disturb the equilibrium. Since balancing was affected by adjustments of the surfaces, instead of by movements of weights, the controlling forces increased in power in the same ratio as the disturbing forces when the machine was suddenly struck by a wind-gust. For this reason we did not seem to experience the same difficulty in managing the machine in high winds, that Lilienthal, who used a different system, seems to have met. Fully half of our glides were made in winds of over ten metres a second, over twenty miles an hour. One day we stopped gliding for a moment to take an anemometer reading, and found that it indicated 16·7 metres a second, 37 miles an hour. Of course, such high winds require much greater readiness on the part of the operator than the low winds, since everything happens much more quickly, but otherwise the difference is not so very marked. In those machines which are controlled by the shifting of weight, the disturbing influences increase as the square of the velocity, while the controlling factor remains a constant quantity. For this reason a limit to the wind velocity which it is possible to safely encounter with such machines is soon reached, regardless of the skill of the operator. With the method we have been using the capacity of control is evidently very great. The machine seems to have reached a higher state of development than the operators; as yet we consider ourselves little more than novices in its management. A thousand glides is equivalent to about four hours of steady practice, far too little to give anyone a complete mastery of the art of flying. Progress is very slow in the preliminary stages, but when once it becomes possible to undertake continuous soaring, advancement should be rapid. Under special conditions it is possible that this point is not so far away as might be supposed. Since soaring is merely gliding in a rising current it would be easy to soar in front of any hill of suitable slope, whenever the wind blew with sufficient force to furnish support, provided the wind were steady. But by reason of changes in wind velocity there is more support at times than is needed, while at others there is too little, so that a considerable degree of skill, experience, and sound judgment is required in order to keep the machine exactly in the rising current. So far our only attempts at soaring have been made on the Little Hill, which has a slope of only seven degrees. In a wind blowing from 11 to 16 metres a second, we frequently made glides of 8 to 15 seconds' duration with very little forward motion. As we kept within five or six feet of the ground, a momentary lessening of the wind speed, or a slight error in management, was sufficient to bring about a landing in a short time. The wind had too little rising trend to make soaring easy. The buzzards themselves were balked when they attempted to soar on this hill, as we observed more than once. It would be well within the power of the machine to soar on the Big Hill, which has steeper slopes, but we have not felt that our four hours of practice is sufficient to justify ambitious attempts too hastily. Before trying to rise to any dangerous height a man ought to know that in an emergency his mind and muscles will work by instinct rather than by conscious effort. There is no time to think."

The experiments continued over a period of five weeks, but many days were lost owing to rain or insufficient wind. Whenever the wind fell below six miles per hour very hard running was required to get the machine started. A relative speed of at least 18 miles an hour was required for gliding, while to obtain a speed of 12 miles required great exertions. With a wind of 20 miles an hour Mr. Wilbur Wright describes gliding as a real sport. Starting is then easy, and the labour of carrying the machine back up hill is performed with the wind. When the wind rose to over 16 metres a second more than 100 glides were made with much less physical exhaustion than resulted from 20 or 30 glides on days with only a light wind.

No record was kept of the exact number of glides, but it is estimated at something between 700 and 1,000. The longest glide was 622½ feet, and the time 26 seconds. It is stated that though the principal object of these experiments was to acquire skill and management of a gliding machine, efforts were also made to obtain data for the study

of some of the scientific problems involved in flight. "Observations were almost constantly being made for the purpose of determining the amount and direction of the pressures upon the sustaining wings; the minimum speed required for support; the speed and angle of incidence at which the horizontal resistance became least; and the minimum angle of descent at which it was possible to glide. To determine any of these points with exactness was found to be very difficult indeed, but by careful observations under test conditions it was possible to obtain reasonably close approximations. It was found that a speed of about 16 miles an hour would produce a pressure sufficient to support machine and operator, but the angle of incidence was too great for general gliding purposes. At 18 miles the angle of incidence was about eight degrees, and the machine would glide on the little hill, descending at an angle of a little over seven degrees. Although the wings were inclined slightly above the horizon, the machine continued to glide without loss of velocity. With a speed of 22 miles an hour the angle of incidence required for support was four or five degrees, and the angle of descent a little less than seven degrees. At this speed the surfaces were inclined several degrees below the horizon. As the speed became greater the angle of incidence continued to grow less, but the angle of descent became greater again, thus showing that the point of minimum resistance had been passed. Scores of glides were made at angles of descent under six degrees, and in a few cases we reached five degrees. On the last day of experiment we made a few attempts at records. A line was drawn a short distance up the slope as a starting mark, and four trials were made. Twice the machine landed on the same spot. The distance was 156½ feet, and the angle of descent exactly five degrees; time, 6½ seconds. From a point higher up the slope the best angle was 5 degrees and 25 minutes, for a glide of 225 feet; time 10¼ seconds. The wind was blowing about nine miles an hour. The glides were made directly to windward, and straight down the slope. Taking seven degrees as a conservative estimate of the normal angle of descent, the horizontal resistance of the machine was 30 pounds, as computed by multiplying the total weight, 250 pounds, by the tangent of the angle of descent. This resistance remained nearly constant at speeds between 18 and 25 miles an hour. Above or below these limits there was a somewhat rapid increase. At 18 miles the power consumed was 1½ horse-power; at 25 miles, two horse-power. At the slower speed, 166 pounds were sustained for each horse-power consumed; at the higher speed, 125 pounds per horse-power. Between 18 and 25 miles the horse-power increased almost in exact ratio to the increase in speed, but above or below these limits the power increased rapidly, and with a constantly accelerating ratio."

Mention is made of the observation of a peculiar phenomenon during the above-mentioned glides. On one occasion Mr. Orville Wright noticed in several glides a peculiar tapping, as if some part of the machine was loose or flapping. Careful search for the cause was made in vain. Some weeks later, while Mr. Wilbur Wright was gliding, the same tapping occurred in the middle of a wind gust and felt to him like "little waves striking the bottom of a flat-bottomed tow boat." While he was wondering what the cause could be, the machine suddenly, but without any noticeable change in its inclination to the horizon, dropped a distance of nearly ten feet and rested flat on the ground. He felt convinced that the gust went out with a downward trend which struck the surface on the upper side. The descent seemed at first more rapid than that due to gravity, for his body rose off the machine till only his hands and feet touched it. Towards the end the descent became slower. "It may be that the tapping was caused by the wind rapidly striking the surfaces alternately on the upper and lower sides. It is a rule almost universal that gusts come on with a rising trend, and die out with a descending trend; but on these particular occasions there must have been a most unusual turmoil during the continuance of the gust, which would have exhibited a very interesting spectacle had it been visible to the eye."

Irregularities of the wind seem most noticeable when the wind is high, on account of the greater power then exhibited, but light winds show almost equal relative variations. In every glide variations in velocity, and directions in upward or downward trend, have to be encountered. The variations not only cause those disturbances of the equilibrium which come from the travel of the centre of pressure due to the changed angle of incidence, but also owing to the fact that the wind changes do

not occur simultaneously or uniformly over the whole surface of the machine, set up other disturbances still more troublesome. A sudden gust, we are told, will strike the front of the machine and throw it up before the back part is acted upon at all. Again, the right wing may meet a wind of very different velocity and trend from the left wing, and in this case the machine tends to turn over sideways. It is the opinion of the experimenters that though the problem of overcoming these disturbances by automatic means has engaged the attention of many ingenious minds, in their opinion it has seemed preferable to depend entirely on intelligence for the control. In all their machines, the maintenance of the equilibrium has been dependent on the skill and constant vigilance of the aviators.

2.—With the Power Flyer.—Communicated by Mr. Orville Wright.

Since the above-mentioned experiments with machines which depend upon gravity for their motive power, the brothers Wright have made successful flights with their power flyer, which is supplied with a motor.

Regarding these latter experiments, fearing lest members of the Aëronautical Society of Great Britain may have been misled by some of the erroneous statements that have appeared in the late accounts of the flights, Mr. Orville Wright has communicated to the Society a true and authentic account of these experiments, which is as follows :—

On the morning of December 17th, between the hours of 10.30 o'clock and noon, four flights were made, two by Mr. Orville Wright and two by Mr. Wilbur Wright. The starts were all made from a point on the levels and about 200 feet west of our camp, which is located a quarter of a mile north of the Kill Devil Sand Hill, in Dare County, North Carolina. The wind at the time of the flights had a velocity of 27 miles an hour at 10 o'clock, and 24 miles an hour at noon, as recorded by the anemometer at the Kitty Hawk weather bureau station. This anemometer is 30 feet from the ground. Our own measurements, made with a hand-anemometer at a height of four feet from the ground, showed a velocity of about 22 miles when the first flight was made, and 20½ miles at the time of the last one. The flights were directly against the wind. Each time the machine started from the level ground by its own power alone, with no assistance from gravity or any other sources whatever. After a run of about 40 feet along a mono-rail track, which held the machine eight inches from the ground, it rose from the track and, under the direction of the operator, climbed upward on an inclined course till a height of 8 or 10 feet from the ground was reached, after which the course was kept as near horizontal as the wind gusts and the limited skill of the operator would permit. Into the teeth of a December gale the "Flyer" made its way forward with a speed of 10 miles an hour over the ground, and 30 to 35 miles an hour through the air. It had previously been decided that, for reasons of personal safety, these first trials should be made as close to the ground as possible. The height chosen was scarcely sufficient for manœuvring in so gusty a wind and with no previous acquaintance with the conduct of the machine and its controlling mechanisms. Consequently the first flight was short. The succeeding flights rapidly increased in length and at the fourth trial a flight of 59 seconds was made, in which time the machine flew a little more than a half mile through the air, and a distance of 852 feet over the ground. The landing was due to a slight error of judgment on the part of the operator. After passing over a little hummock of sand, in attempting to bring the machine down to the desired height, the operator turned the rudder too far, and the machine turned downward more quickly than had been expected. The reverse movement of the rudder was a fraction of a second too late to prevent the machine from touching the ground and thus ending the flight. The whole occurrence occupied little, if any more, than one second of time.

Only those who are acquainted with practical aeronautics can appreciate the difficulties of attempting the first trials of a flying machine in a 25-mile gale. As winter was already well set in, we should have postponed our trials to a more favourable season, but for the fact that we were determined, before returning home, to know whether the machine possessed sufficient power to fly, sufficient strength to withstand the shock of landings, and sufficient capacity of control to make flight safe in boisterous winds, as well as in calm air. When these points had been definitely established, we at once packed our goods and returned home, knowing that the age of the flying machine had come at last.

From the beginning we have employed entirely new principles of control; and as all the experiments have been conducted at our own expense, without assistance from any individual or institution, we do not feel ready at present to give out any pictures or detailed description of the machine.

The Altimeter.

An ingenious little instrument for registering altitude has been devised by Messrs. Newton, called the Altimeter, which is likely to be useful to both balloonists and kitists. The instrument is clearly shown in the accompanying illustration.

The full size instrument in an aluminium case weighs about seven ounces. The scale is divided to five feet, reaching to 5000 feet, on a 2½-inch face; so the scale is very open and easy to read. To adjust the instrument it is turned upside down. The small plate is slid down to uncover the hole at the side, which allows a pin to project. This is pushed in a little so as to release the detent, and the hand of the barometer will read the mean atmospheric pressure. The instrument is then held upright and the altitude scale turned to zero opposite the hand. The instrument is then in adjustment ready to send up. As the machine rises the hand goes down, and is held in check by a mechanical arrangement inside which does not allow the hand to return, it working only in one direction, so that when the aerial machine has attained its greatest height it stops all action. The difference between zero and the hand is the height. The hand will be found to point to the highest altitude attained by the kite, so that no calculation or deduction has to be made.

THE FLAPPING OF A BIRD'S WINGS AFTER DEATH.

Dear Sir,—The following note may be of interest, as everything connected with the flight of birds is doubtless of interest, and may be of importance, to aëronautics, and I am not aware that attention has been drawn to the fact before, viz., that if a large bird quite recently shot is held so as to present its under-surface to a brisk wind of 20 miles and upwards, the wings will flap energetically and continuously for some time. The first time that I observed this was in carrying a brent goose which I had just shot; a strong breeze blowing inland at the time tossed the bird about in my hand, which caused it to turn, when suddenly the wings began to flap, making me believe that the bird was still alive; but when, preparatory to laying down my gun in order to kill it, I turned my back to the wind, the wings ceased to flap. I discovered that the bird was truly dead. I then found that whenever I presented the under-surface directly against the wind, the wings commenced flapping, and continued to do so till the muscles began to grow rigid. One thing remarkable about the beat of the wing was that the amplitude of the stroke into the wind, the down-stroke, was much greater than the up-stroke.

I had the opportunity of observing the same thing a couple of days ago, on shooting a fine specimen of the great black-backed gull, when, on holding it by the beak and presenting its under-surface to the wind, the right wing began to flap energetically, the left hanging down without any motion, except being borne back by the wind, the reason for which I subsequently found to be that the head of the humerus and coracoid were broken by the shot. The beat of the right wing seemed quite natural, the elbow flexing at the end of the down-stroke for the up-stroke; but the up-stroke was very short, which gave a flurried appearance to the flapping.

Can it be inferred from this that the rowing action of the wing is automatic, depending on the manner the wind strikes the under-surface, and that it is only emphasised by the bird? I mean that the bird does not have to apply its muscular power till the end of the stroke, and giving the stroke a voluntary character. If this is so, it would go a long way in explaining the tireless flight of the migratory bird, and also how mathematicians have erred in demanding so great a power as necessary for flight; it might also give some hope that a man by his own power might raise himself, with properly constructed and jointed wings. One sees, by the motionless left wing of the gull, that the wings must be properly hung. I have tried in a similar way small birds after just being shot, but I could detect no tendency for the wings to flap.

Yours, etc.,
T. H. Hugo.

NOTES.

The Journeys of the Lebaudy Airship.—In the October number of this journal some details were given of the Lebaudy airship. Since the publication of those details the Jaune has made two record journeys, the first of which was distinguished for being the longest voyage yet covered by a navigable balloon; the second for having successfully combatted the highest wind force yet overcome by any airship. The *New York Herald*, of November 13 last, perhaps hardly exaggerates the importance of this journey when it states that the date of November 12, 1903, will soon be a glorious one in the annals of aeronautics. On this date the airship made a journey from Moissan to Paris, and landed at a previously selected point on the Champs de Mars. Though the wind was contrary, a distance of about 65 kilometres was traversed. An average speed of about 37 kilometres was maintained throughout the long voyage.

The last journey of the year, on November 20, was, however, still more remarkable, as on that occasion the airship faced a wind estimated at ten metres a second, and in the teeth of this the Jaune made a journey from the Galerie des Machines to the Military Balloon Park at Meudon. Before the airship descended it is stated that the wind rose to 15 metres a second, and that it was the force of the increased wind which ultimately blew the airship against a tree with disastrous consequences to its envelope. Though unfortunately, an accident terminated the journey, Colonel Renaud, chief of the Military Balloon Park, thus gave his opinion to the reporter of the *New York Herald*:—"The fact that the balloon held its own against a wind of this speed so long as its propellers were in movement proves that the experiment made to-day has been the most conclusive yet attempted. An airship can be driven against the wind. This has been proved in scientific fashion. Aerial navigation is no longer an Utopia."

The Purification of Hydrogen by Liquid Air.—In a recent number of *Photography* there appears an interesting account of Mr. Georges Claude's apparatus for purifying hydrogen by liquid air. It appears that even from ordinary illuminating gas the carbon additions to hydrogen can be eliminated by means of liquid air. Before constructing apparatus for purifying the hydrogen on a large scale it was thought advisable to determine by experiment on a small scale to what temperature the hydrogen must be lowered to free it from arsenious hydrogen and other deleterious gases. The experimental device consisted simply of a cylindrical glass vessel, five inches in diameter, half filled with gasoline, through which the impure gas produced from commercial acid and zinc was passed by means of a tube dipping into the liquid. In the centre of the vessel was placed a test tube, first of glass, but afterwards of copper, in which was poured liquid air. The gasoline bath was thus given a temperature of 130° C. without difficulty. Each sample of hydrogen to be tested consisted of about one gallon, and it passed over at the rate of a quarter to half a gallon per second. The qualitative analysis of the gas was then made with great care at the laboratory of the Artillery section. The result of the experiment showed that the arsenic was practically eliminated at 110° C., and it may be considered certain that by cooling to 130° C. the arsenic may be totally removed.

It is stated that the Aërostatic Establishment at Meudon is considering the adoption of the process.

Sir Hiram Maxim's Captive Flying Machine.—On the afternoon of March 17 the friends of Sir Hiram Maxim had an opportunity of foretasting some of the sensations which will, doubtless, be felt when a true flying machine has been invented. The gigantic toy which Sir Hiram Maxim has erected, and which he calls a captive flying machine, consists of the following apparatus: A vertical steel shaft of great strength and height is erected. To this is attached ten very long radial arms supported by steel wire ropes. To the ends of these arms are slung cars, made in the shape of fish or in the shape a flying machine is supposed to be, or, in fact, in any other convenient or attractive form. Each of these cars is provided with an aëroplane or some means of causing it to swing outward and upward while it is travelling round a very large circle. The circle is so large that the rotation does not have to be rapid, but the actual speed will have to be sufficiently high to give a considerable lifting effect to the aëroplanes, so that by changing their angle and their lifting effect the cars may be made to perform some very interesting and complicated evolutions in the air. Sir Hiram Maxim has explained that his object

in inventing what should certainly be a fascinating new pastime is to obtain by its means the funds to enable him to set to work on the real flying machine which it is his ambition to produce. All who appreciate Sir Hiram Maxim's past work on this problem, and who realise that to his pioneer work of attacking it on sound scientific principles, is due that now general interest of scientists in the subject of aerial navigation will wish success to his merry-go-round and the speedy enrichment of his treasury of aerial research.

Scientific Kite Flying.—At a recent meeting of the Royal Meteorological Society, Mr. W. Dines gave an account of the observations he had made by means of kites off Crinan, on the west coast of Scotland, during last summer. The weather was unfortunately very unfavourable for kite flying, owing to the prevalence of heavy rains and frequent gales. August only afforded three possible days. Thunder was very rare on the west coast of Scotland, and there was a deficiency of wind. On one occasion, however, a nine-foot kite took the instruments to a height of 7,600 feet.

The Possibilities of Vanadium Steel in Airship Construction.—The extreme hardness which characterises vanadium steel would seem to promise a future for its use in airship construction, for by its employment the weight of the steel introduced could be reduced one half. *L'Echo des Mines et de la Metallurgie* has recently published some interesting facts concerning vanadium steel. When from three to five parts per 1,000 of this metal are added to steel, it doubles the coefficients of resistance to fracture under all circumstances, shock, crushing, elongation, &c., and at the same time imparts to it extreme hardness.

The fact that only $\frac{1}{3}$ to $\frac{1}{2}$ per cent. of vanadium can have so intense an effect on steel has been explained to be due to the extreme avidity which vanadium has for oxygen. The presence of the slightest quantities of vanadium in a bath of steel in fusion leads to the immediate and absolute reduction of every trace of iron oxide existing in the mass. It is to the traces of oxide which are inevitable without vanadium that the rupture of the best prepared steels is attributed.

Vanadium steels acquire their maximum of hardness, not by tempering, but by annealing at from 700° to 800° C. This fact has various consequences. If a planing machine whose cutter is of vanadium steel is set to work with great velocity, even when the implement is at a red heat it continues to take off shavings of iron or castings without exhibiting any exhaustion.

The Late M. Lachambre.—The death of M. Henri Lachambre has robbed the world of one of its most famous balloon makers. We say the world, and not only France, because aëronauts of many nations were wont to resort to the famous balloon factory of the eminent French balloon maker at Vaugirard. His aerostatic establishment was founded in 1875, and therein was constructed the balloon of the hapless André as well as the airships of M. Santos Dumont, Sévero, and Baron de Bradsky.

La Société Française de Navigation Aerienne.—Major B. Baden-Powell, the President of the Aëronautical Society of Great Britain, was recently elected a Membre D'honneur of La Société Française de Navigation Aérienne.

Foreign Aeronautical Periodicals.

(In this list a selection of some of the most notable articles is given.)

L'AÉRONAUTE (Paris).

January, 1904.—Ascensions en Espagne et en Portugal; M. Carton. Aérostation et Aviation.

February.—Note sur les éléments de l'appareil du vol dans diverses espèces d'oiseaux; M. Sébillot.

March.—Sur les cerfs-volants; Le Loup.

L'AÉROPHILE (Paris).

February, 1904. — Portraits d'Aéronautes Contemporains; Camille Dartois; Georges Blanchet; Aéronat Mixte; Robert et Pillet; Albert De Masfrund.

ILLUSTRIERTE AËRONAUTISCHE MITTEILUNGEN.

January, 1904.—Dokumente für die Versuche mit Lebaudy's Luftschiff; Hermann W. L. Moedebeck; Berliner Verein für Luftschiffahrt.

February. — Die Dauer-oder weitfahrten. Das Luftschiff Deutsch Ein Besuch bei A. M. Herring; Dienstbach. Professor S. P. Langley's Gegenwärtige Versuche; Dienstbach.

March.—Uber den Luftwiderstand Welchen bewegte kugeln erfahren; Prof. D. H. Hergesell. Die erfindung der Flugmaschine. Der Motorflug der Gebrüder Wright.

WIENER LUFTSCHIFFER-ZEITUNG.

January.—Friedrich Ritter von Loessi. Eine Hochfahrt auf 5,750 meter; J. Valentin.

February.—Der stand der Luftschiffahrt. Das Ballonet; Herbert Silbuer. Henri Lechambre. Der Experimentelle Nachweis meiner Theorie. Durch Friedrich Ritter von Loessi.

March.—Die Fiellung des Ballons. Heenz Ziegler. Der Gleitsport.

Current Aeronautical Articles.

1904.

Jan. *Pall Mall Magazine.*—"How it Feels to Navigate the Air." By Albert Santos Dumont.

1. *New York Herald.*—"New Airship belonging to M. Henry Deutsch (De la Mentre)."

8. *Daily Paper.*—"Radium Problems.—The Force that is to Drive our Airships."

23. *Daily News.*—"Proposed Twin Airship."

30. "The World's Finest Balloon Corps."

Feb. 17. *The Tatler.*—"Why I became an Aëronaut."

24. *Sketch.*—"Mr. Archdeacon's New Airship."

Mar. 9. *Globe.*—"Andrée's Balloon."

12. *Literary Digest.*—"The Wright Aëroplane."

25. *English Mechanic.*—"Kite Flying."

Applications for Patents.

(*Made in January, February, and March.*)

The following list of Applications for Patents connected with Aëronautics has been specially Compiled for the AËRONAUTICAL JOURNAL by Messrs. BROMHEAD & Co., Patent Agents, 33 Cannon Street, London, E.C.

JANUARY.

234. January 5. JAMES TOWNSLEY PEARSON. Revolution of aeriel flight and balloons and airships.

1446. January 20. ALFRED HENRY AVERY. An improved form of blade or vane for fans, aerostats, propellers, wind motors, and the like appliances for imparting to or deriving motion from air, gases, and liquids.

1536. January 21. THEODORE HENRY STRINGER. A new form of propeller for aerial navigation.

1543. January 21. EDWARD CAESAR HAWKINS.

1763. January 23. MALCOLM CAMPBELL MACLEOD. A new method of raising and giving the initial impetus to flying machines and the like.

1778. January 23. FREDERICK WILLIAM HUTCHISON HUTCHISON. Improvements in fittings connected with aeronautical machinery.

1788. January 23. GEORGE MCMULLEN. Improvements in aeronautical apparatus.

1845. January 25. ALFRED FOSTER. Improvements in airships.

FEBRUARY.

3307. February 10. LADISLAV VOJACEK. Improvements in devices for aerial navigation.

3336. February 10. STEFAN HUNYOR DE VISOLY. Improvements in or relating to flying machines or apparatus.

3438. February 11. SABATINO DI LAURO. Improvements in flying machines.

3929. February 17. ROBERT LINDSAY CRAWFORD. Improvements in flying machines, in connection with means of supporting and balancing them in the air.

4086. February 18. JOSEF REHULKA. Flying machine.

4558. February 24. PICKLES BINNS. Improvements in and relating to aeronautical apparatus.

4901. February 27. HENRY ADAMS. A mechanical means of propelling and steering an ordinary gas balloon driven by flexible shafts.

MARCH.

5915. March 10. CHARLES GODFREY WOODHEAD. Improved apparatus for counteracting or reducing the effect of gravity on bodies such as airships and the like.